RAW SEQUENCE LISTING DATE: 08/15/2001 PATENT APPLICATION: US/09/847,513A TIME: 14:21:16

Input Set : A:\PTO_VSK.txt

Output Set: N:\CRF3\08152001\I847513A.raw

```
ENTERED
      5 <110> APPLICANT: MBARI
              DeLong, Edward
              Beja, Oded
     13 <120> TITLE OF INVENTION: Light-driven energy generation using proteorhodopsin
     17 <130> FILE REFERENCE: MBA-101
     21 <140> CURRENT APPLICATION NUMBER: US/09/847,513A
     23 <141> CURRENT FILING DATE: 2001-05-01
     27 <150> PRIOR APPLICATION NUMBER: 60/201,602
     29 <151> PRIOR FILING DATE: 2000-05-03
     33 <160> NUMBER OF SEQ ID NOS: 65
     37 <170> SOFTWARE: PatentIn version 3.0
     41 <210> SEQ ID NO: 1
     43 <211> LENGTH: 105184
     45 <212> TYPE: DNA
     47 <213> ORGANISM: Naturally occurring gamma proteobacterium
     51 <220> FEATURE:
     53 <221> NAME/KEY: gene
     55 <222> LOCATION: (50866)..(51615)
     57 <223> OTHER INFORMATION: Proteorhodopsin gene sequence.
     61 <220> FEATURE:
     63 <221> NAME/KEY: misc_feature
     65 <222> LOCATION: (1593)..(2807)
     67 <223> OTHER INFORMATION: Predicted threonine dehydratase. Contains 'n' at position
2753.
     72 <300> PUBLICATION INFORMATION:
     74 <301> AUTHORS: Beja,O., Aravind,L., Koonin,E.V., Suzuki,M.T., Hadd,A.,Nguyen,L.P.,
             Jovanovich, S.B., Gates, C.M., Feldman, R.A., DeLong, E.F.
     77 <302> TITLE: Bacterial rhodopsin: evidence for a new type of phototrophy in the sea
     79 <303> JOURNAL: Science
     81 <304> VOLUME: 289
     83 <305> ISSUE: 5486
     85 <306> PAGES: 1902-1906
     87 <307> DATE: 2000-09-15
    89 <308> DATABASE ACCESSION NO: AF2791069
     91 <309> DATABASE ENTRY DATE: 2000-06-15
    93 <313> RELEVANT RESIDUES: (50866)..(51615)
     97 <400> SEQUENCE: 1
                                                                               60
     98 ttqttatatc aqtaatqqct attqctccaa taacttaata ctaatatata attagtttat
    100 qaataaattt tatatatttq qqttattqtt ttttacacta aatgcatttt cttgctcaga
                                                                               120
    102 tettetagat acagacatga gagttettga tteegetgag teaagaaace tttgcgagtt
                                                                               180
    104 tgaaggaaaa gctttactag ttgtgaatgt tgcaagtaga tgtggttaca cttatcaata
                                                                               240
                                                                               300
    106 tqctqqcctt caaaaqttat atqaaaqtta taaaqatqaa gattttctag taattgggat
    108 cccatctaga gattttcttc aagaatactc tgatgaaagc gatgttgcag aattttgttc
                                                                               360
    110 tacagaatac ggtgttgaat ttcctatgtt ctcaactgct aaagtcaaag gaaaaaaagc
                                                                               420
    112 acacccattt tataaaaaac ttattgcaga atcaggtttt actccctcat ggaactttaa
                                                                               480
    114 taaatactta atctcaaaag agggcaaggt tgtatccaca tatggatcaa aggtaaagcc
                                                                               540
                                                                               600
    116 tgattcaaaa gagcttatat cagctataga aggcttgctg taaaattatt acttagaaac
```

118 taatacagtt ttaggcttgt ttgctgcaaa tattccatta tctacaactc caggaatatt

660

RAW SEQUENCE LISTING
PATENT APPLICATION: US/09/847,513A

DATE: 08/15/2001
TIME: 14:21:16

Input Set : A:\PTO_VSK.txt

Output Set: N:\CRF3\08152001\1847513A.raw

						atattagaga		720
	122	gtgattacct	tggtctgtta	taaatccagt	tctatatgtg	ggtattccac	cgatcgagat	780
	124	tatttttctt	gcaacaaggc	tcctactttc	aggtatcacc	tctataggca	gtggaaaagc	840
	126	tcccaaaaga	ttaaccatct	ttgactgatc	aactatacat	ataaactcgt	tagaggcaga	900
	128	agcaactatc	ttttctctag	tatgtgcgcc	accaccacct	ttaataagac	aattttcagg	960
	130	agacacctca	tctgcaccat	ctatgtaata	agctatatca	actacatcat	taaggctaaa	1020
	132	gacctctatc	ccattttcat	ttaataattt	tgatgaagca	tctgaactag	aaacagctcc	1080
	134	agcaaatttg	tgcctatgct	cctttagttc	ttctataaaa	aaattaactg	ttgagccggt	1140
	136	tccaatacct	aaaatcatct	caggatgaag	attatttttg	atatattcta	tagcttgttt	1200
	138	agcaacattt	atctttgagc	cactcataga	gttataatac	aagaaaatat	aggtagttaa	1260
	140	ttattttgag	actaaaaatt	aaaaaaacag	gttcttttaa	gaattcccag	aagtacctaa	1320
	142	agcttattcc	taatgcatct	gtttatgacg	tagcattaaa	atcacctata	acatttgctc	1380
	144	taaatatttc	ttcaaagctg	gggaataaag	ttttcctaaa	aagagaggat	ctgcaaccta	1440
	146	tattttcttt	taaaaacaga	ggagcgtata	acaagattgt	aaatttatcc	gatgccgaaa	1500
	148	agaagagggg	ggttattgct	gcatcagcag	gaaatcatgc	tcaaggggta	gccagtgcat	1560
						aacaactcca		1620
						tggggacaac		1680
	154	cattaaaaga	ggcactgttt	attgcaaaga	aaaaaaatt	gtcttttgtt	catccttttg	1740
						agaaattctt		1800
	158	ataattttga	tgttgtcttt	gttccggtgg	gaggaggagg	tattctagct	ggtgtatctg	1860
	160	cctggatagc	acagaataat	aagaaaataa	aaattgttgg	tgttgaggtt	gaggattccg	1920
						tttaaaagaa		1980
						ttttgatgtt		2040
	166	gcgtagatga	agtcattaca	gttagcgttg	atgaggtctg	caccgctgta	aaagatatct	2100
	168	ttgaagatac	aagggttcta	tcagaacctg	ctggggcatt	agcacttgca	gggttaaaag	2160
					_	aagttctggc	-	2220
						tggtgaaaat		2280
		_				taagctttca		2340
						cttaagcgat		2400
						cttaaagtcc		2460
						atccaatgat		2520
						caatgaaaga		2580
						agagaaattt		2640
						ttttggaaag		2700
•						aaataagtca		2760 ₀ jl
						aaaatgaaag		2820
						tcccacggct		2880
						ccacctttag		2940
		-				atttggaacg		3000
		-				tatccattag	_	3060
						ctcttaagtc		3120
						tcttgtcttg		3180
						tcctttctta		3240
			-		•	gctatcttgt		3300
			_	-		ttaaagaagc		3360
						gctgtaatac		3420
						atagttgtat		3480
						ttaaaactaa		3540
	7 ⊥6	ttgatcgatg	cctattggat	ttgaattacc	agctgtgtca	gcatcataat	ttagatcaat	3600

W-->

RAW SEQUENCE LISTING
PATENT APPLICATION: US/09/847,513A
DATE: 08/15/2001
TIME: 14:21:16

Input Set : A:\PTO_VSK.txt

Output Set: N:\CRF3\08152001\1847513A.raw

218	tccataatct	atttgtttta	atatcgagct	attatcaaat	tcatttattt	ttcgatttcc	3660
					ccaaagtcat		3720
					agtttatttg		3780
		-		-	tctgaggcta		3840
					ataacattga		3900
					ccaagcgttt		3960
					gaaaaggctt		4020
	, ,		_		tgagtaagtc	_	4080
					tcttcattac		4140
					ataaccgagt		4200
					gctctttttt		4260
					tcagcttgtc		4320
					taaaagattt		4380
					gatatatatg		4440
					aactcttgaa		4500
					ttttcggcac		4560
					ttcattaacg		4620
							4680
					tgtgtttttg		4740
					atggcatcga		
	=			-	ccatcaaagt		4800
			_		gtcttcctgg		4860
		-			tccttatttg	-	4920
			_		gatgtttcat		4980
					ccatcaataa		5040
					gctaaagtta		5100
					aatcatccga		5160
					atgcatatta		5220
					ctcgtttata		5280
					atttaaatca		5340
					atcttcactt		5400
					cagcaaatta		5460
	-				aagtttagta		5520
					taaggcaatg		5580
		-			aaaacttata		5640
	-		_		tcgtatttta		5700
					gctatacctg		5760
				_	aggtactgcg		5820
					ttaacacatt		5880
					aaagttaatt		5940
					tttaaagcag		6000
					ccagctatca		6060
					tttgcagctc		6120
	_				ccaaaaattc		6180
					ctttatttag		6240
					ttattccttt		6300
					ataatgatga		6360
					aaagtttctt		6420
					gagattcact		6480
314	ctacctaaga	attcagcctt	aattgtacct	ggtgcagatt	tgcaatatag	aaatgctgac	6540

RAW SEQUENCE LISTING DATE: 08/15/2001 PATENT APPLICATION: US/09/847,513A TIME: 14:21:16

Input Set : A:\PTO_VSK.txt

Output Set: N:\CRF3\08152001\I847513A.raw

316	tcatcttata	atttaagaca	ggaaagtagc	ttctactatc	tgtctggctt	ttgtgagccc	6600
			taataatgga				6660
			aatctgggat				6720
	-	-	agcttttgaa				6780
			agttttttat				6840
326	aaagtaattg	actggacatg	cgcagcaaat	tctaaagata	ggcacagcaa	atcaattgat	6900
			ggtaggaaat				6960
330	gatattatga	agagagcttg	tgaaatttca	gctgaatcat	atattgaggt	catgaaatct	7020
			gcaggaaata				7080
			ttatacacct				7140
			taaagagtta				7200
			tgcatctgat				7260
340	ttttcagatg	aacagctaca	aatttataat	attgtccaca	aagccaatct	tgctgcaatc	7320
342	gatgctgtaa	aaactggtaa	tagcataatg	gagccccaaa	tggtttcaga	aaaagtaatt	7380
344	actgaaggtc	ttgtagagtt	gggtattcta	tctggcgatg	ttaatcagct	tcataaaaat	7440
			tatgcataag				7500
348	gatgttggtg	actacatgga	gggagatgag	tttatgaagt	ttaagccagg	gatgataacc	7560
350	acaatcgagc	caggcatcta	tatcagtagc	gcaatggatg	tagatgacaa	atggaaaggc	7620
352	atcggcataa	gaatagagga	cgacatcctt	gtaacagatt	caggcaatat	taatctaaca	7680
			tcaagaaata				7740
356	ccaattgtta	tttctggcgg	agggataata	ggtaattaca	tttctcttag	gcttgaaaaa	7800
358	aataatatca	aaaccgttat	tgtcgaaaaa	gctagtagtt	tcaaagccct	agataagggt	7860
360	ataagaacag	tcactctcaa	tgagcattct	atgcaaatgc	taaaaaatat	tggtatttgc	7920
362	ccatcaattg	ctcaaatcaa	cagcatcgac	gtattagatg	gtgagggtac	aggcaaaatt	7980
364	caatttctag	caaaggacgt	aggcagcgaa	aacctttcat	atgtaaccta	tttcaatgaa	8040
366	ttacaaaaac	taatttctga	tccatgtaaa	gaaagaacct	tatttaataa	tgagattgat	8100
			agaatctgat				8160
			tggatgtgat				8220
			tgactactta				8280
			agctcaccaa				8340
376	atgccactcc	cagaaggcaa	gggtgagatg	aataaatgca	cagtggtttg	gtcaataaaa	8400
	_		gcctgtatct				8460
			tctcagggtt				8520
			tattagcgga				8580
			tcaaggtatt			-	8640
			ttataaaaaa				8700
	-		aaaaagtatg	A CONTRACTOR OF THE CONTRACTOR			8760
			agaaaattta				8820
392	tcttcgttaa	ataaatcaaa	gtttgttaaa	gcattcttta	taagacatgc	ctctggaatg	8880
	•	_	taaacttttt	-	-	_	8940
			atgattctca				9000
			caaaatttgt				9060
			gaaacattgt				9120
			acgcgatttt				9180
			tacggcatgc	_		_	9240
	-	-	caagaaaagg		_	_	9300
	-		tagtagataa	_		-	9360
			gtgatgggct				9420
412	tgatgagctt	tacttttctg	gccctggtga	gatcgttaag	cttatccaaa	gtttaagtga	9480

RAW SEQUENCE LISTING DATE: 08/15/2001 PATENT APPLICATION: US/09/847,513A TIME: 14:21:16

Input Set : A:\PTO_VSK.txt

Output Set: N:\CRF3\08152001\1847513A.raw

414	attcatttcc	totottttaa	taataggcca	caatccatca	atgcaaatgt	acatagatgc	9540
			ttacgtattc				9600
	_		ctttaaaaaa				9660
			acataaaaat	-			9720
		_	aaacaaaggg	-			9780
			aagcaggaac				9840
			ttgcagcaat				9900
	-		atctggttgg				9960
			gatcagatac		_		10020
			cagtgattca		_		10080
		_	agggttttgg				10140
	•		caaatttctg		_		10200
	_		gagaagcaga	_	_	_	10260
							10200
			tcgtttgagt	-			10320
			ggaataaaac				10380
		-	gatgagaact				
			gacatagctg				10500
		-	acaaaaggaa		_		10560
			aaaaatattc				10620
			gtacttgatg				10680
			gattactatc				10740
			aaaattaata				10800
			gatgataaga				10860
			tctaaaggat				10920
			tacttaagag				10980
		_	gaaataaatt				11040
	_		ggcatatatc	_			11100
			tttggttcta				11160
			attggtttaa				11220
			aaattctctg				11280
			ttgggatcag			_	11340
			agagttgata				11400
		-	atcaataaca	_			11460
			accatagaca				11520
		_	tatcaatgta				11580
		_	ttccaccagg	_			11640
486	aatctgccta	ctctgttaat	ttgtcttgtc	cggcatgcaa	gtctaatgac	tttaatatgt	11700
488	atggagctgg	aacagagaga	gttgaagaag	ttcttaaaag	cagctttgta	aagactccaa	11760
			tcaacaaaaa				11820
492	aaattcattc	ctcagacgca	gcaattttag	ttggaactca	aatgcttgca	aaaggacatg	11880
494	attttcctaa	agtcacctta	agcgttattt	taaatgctga	taatggcctt	ataagcccag	11940
496	aaattaatgc	attagagaaa	atatctcaat	tgcttattca	ggtctctgga	agagcaggaa	12000
498	gaaataataa	tcttgcaaaa	gttattattc	aaacaagata	tcctgatgat	ataaatctta	12060
500	ataaaattaa	gacaggagat	tatatgaaat	ttgcttctca	atgcctaagt	accaatgagc	12120
502	aaatgaactt	acctccattt	actactttat	gtctgcttag	gtgctcatca	ccaactcaaa	12180
504	agagtaatgt	agatttccta	gagaaagctg	ttttaatttt	atccaatagg	actgatataa	12240
506	atgttattgg	tcccttgcct	tcattagttt	cgaagtcgaa	aggaaattat	aggcaccaag	12300
508	tctatatcca	tgcaccaaag	aagacttttt	taaataaggt	attaaagttt	ttgacaacag	12360
510	agtttgaaaa	atggccggaa	tctaataagg	ttaagtggtc	tttcgacatt	gatccaatag	12420

VERIFICATION SUMMARY

DATE: 08/15/2001 TIME: 14:21:17 PATENT APPLICATION: US/09/847,513A

Input Set : A:\PTO_VSK.txt

Output Set: N:\CRF3\08152001\1847513A.raw

L:188 M:341 W: (46) "n" or "Xaa" used, for SEQ ID#:1